A large part of the area west of the Cascades had temperature near or above normal, and instead of the cold weather of eastern Oregon extending through the gorge into the western portion the reverse seems to have been true, for a number of places along the Columbia River east of the Cascades had temperature slightly above normal.

It is difficult to determine the length of the growing season in the colder parts of Oregon, for over those regions agriculture is mostly confined to the growing of the hardier crops; moreover, in regions where the nights are so uniformly cool even the less hardy crops seem to develop a degree of resistence to frost. The records of killing frost show that over most of the region west of the Cascades the length of the growing season is more than 150 days, reaching 250 days on the coast. In the principal agricultural districts east of the Cascades it is between 100 and 200 days. Some of the high plateau districts have less than 50 days, and there are regions where frost may occur in any month of the year. However, even in these regions considerable areas are devoted to agriculture, and even some potatoes and garden vegetables are grown.

A preliminary study of the frequency of temperature changes in different parts of the State has given some interesting results, and it is planned to continue these studies as opportunity offers.

At Portland the changes from one 5 a.m. observation to the next are mostly very small. There is little chance of a verifying change and no chance at all of a verification of a cold-wave warning. In the last 10 years the extreme change has been 21°, and this was a plus change; 95 percent of the changes have been less than 10°.

The changes from one p.m. observation to the next at Portland have been somewhat greater, but even here in the last 10 years 88 percent of the changes have been less than 10°, with an extreme of 32°. The greater p.m. changes are quite largely the result of the passing of brief warm periods in summer, and are not the result of the passing of cyclones with well-defined warm and cold fronts.

At Baker, fairly representative of eastern Oregon, the data for the 5 a.m. observations for the last 10 years show a much greater prevalence of large changes. Many of these changes occur in winter, but they may occur at any time. Conditions at Baker are often favorable for rapid cooling by nocturnal radiation, and the local topography favors marked inversions. Because these temperature changes are so largely local they are rather hard to forecast.

Data for the 5 p.m. observations at Baker show a still greater probability of large changes, particularly minus changes. Many of these large changes occur in summer.

No discussion of Oregon temperature would be complete without reference to humidity in its relation to temperature. In the nature of things hot weather in Oregon must be dry weather. Low humidity is the normal summer condition east of the Cascades; extremes of heat west of the Cascades occur only when warm dry air is brought from the interior. For example, in August 1930 which was an unusually warm month at Portland, the reading of the wet thermometer at the 5 p.m. observation did not exceed 70° at any time. The fact that warm periods are also dry renders them less uncomfortable than they otherwise would be.

On the other hand, such cold periods as occur in western Oregon in winter are more noticeable because they are dry. This is particularly true near the mouth of the Columbia Gorge, where cold weather is usually attended by drying east winds, which are in marked contrast to the usual mild, moist winds from the ocean. For example, on the unusually cold day already referred to, January 21, 1930, the relative humidity at Portland was 40 per cent, as compared with a normal of 87 per cent.

In ordinary winter weather at Portland humidity is sufficiently high to simplify the matter of conditioning air in residences and public buildings. The same statement holds true over most of the State, though in a less degree in eastern districts.

A good deal is said from time to time about progressive variations in temperature from year to year. Portland has a complete record for nearly 60 years; the record for Roseburg covers more than 53 years, and that for The Dalles, though somewhat broken in early years, is nearly continuous for the last 56 years. Walla Walla and Boise, just outside the boundaries of the State, have somewhat longer records than Portland, though at Boise part of the records were kept at the military post, just under the foothills, and for this and other reasons may not be strictly comparable with the records now being kept in the city proper. These five records show fair agreement with one another. The most pronounced features are two warm periods, the first culminating in the early seventies and the second about 1926, and two cold periods, the first culminating about 1879 near the coast and about 1883 near the eastern boundary, and the second, somewhat less pronounced, about 1894.

It is generally conceded that as cities grow up around meteorological stations the recorded temperatures are somewhat too high. If this is true it would be expected that the Portland record would show some tendency toward higher temperature in the later years, as compared with records kept in smaller cities. It is found, however, that the later warm periods are quite as pronounced at other places as at Portland. There is very little in the records for any of the stations to indicate a progressive change in temperature.

THE SUMMER NIGHTTIME CLOUDS OF THE SANTA CLARA VALLEY, CALIF.

By EDWARD H. BOWIE

[Weather Bureau Office, San Francisco, Calif., 1933]

The decision of the United States Navy to make its Pacific coast base for airships in the Santa Clara Valley, Calif., in the vicinity and slightly to the north of the Weather Bureau station in San Jose, at a point known as Sunnyvale, is of particular interest to American meteorologists. Apparently this decision was reached only after an extended survey of this and other proffered sites for a Pacific coast base. What the findings and recommendations of the aerologists who made these surveys are is not known to the writer. It is to be assumed, however, that they were aerologically favorable to it, and doubtless led to the decision to recommend the Santa Clara Valley site. This site having been selected, it follows that any information concerning the climate and the day-to-day regime of weather in the vicinity of Sunnyvale base cannot fail to be of interest to the climatologist and to the meteorologist.

This study has been restricted to the daily regime of cloudiness in the summer months in the vicinity of San

Jose, as it will not be possible in the short space available to present many of the known and interesting facts concerning the climate and weather of the Santa Clara Valley.

The Santa Clara Valley is flooded of summer afternoons by highly humid air of marine origin, 1,000 to 1,500 feet deep, roughly. Above this marine air there is a stratum of undetermined thickness of much less vapor content and also warmer in its under portion, as shown by the aerographic flights made in the vicinity of Sunnyvale. The origin of this drier stratum of air is not definitely known, though it occurs widely along the California coast in the summer months.

The following are typical of these airplane logs.

11:05 A.M., JULY 31, 1931

Altitude	Pressure	Temperature	Relative humidity
Meters	*Millimeters*	° *C.*	*Percent*
Surface	759	20.0	66
503	713	14.4	77
1,204	657	23.0	12
1,575	630	21.2	18
1,910	606	19.0	11
3,261	516	14.2	0

NOTES.—At take-off few scattered Stratus clouds, bases 488 meters. Dense haze from surface to 914 meters. Thick bank of Stratus along the coast, tops about 2,438 (sic) meters.

9:51 A.M., AUG. 7, 1931

Altitude	Pressure	Temperature	Relative humidity
Meters	*Millimeters*	° *C.*	*Percent*
Surface	762	22.0	59
300	736	17.5	72
1,321	654	23.5	6
2,972	538	10.9	18
3,282	517	8.9	22

NOTES.—At take-off sky was cloudless. Moderate haze from surface to 488 meters. Light haze to southeast above 488 meters. Observed a few Alto Stratus clouds to the east from 914 meters. Thick bank of fog along the coast. Visibility improving during flight.

9:53 A.M., SEPT. 2, 1931

Altitude	Pressure	Temperature	Relative humidity
Meters	*Millimeters*	° *C.*	*Percent*
Surface	762	16.8	76
396	728	12.8	81
742	699	19.8	34
1,219	662	23.0	21
2,022	604	19.0	15
3,343	515	10.0	22

NOTES.—At take-off eight tenths Stratus from the west, base 183 meters, top 488 meters. Moderate haze from 488 meters to 1,524 meters. Base of inversion 518 meters. Thick bank of Stratus along the coast. Clouds dissipating rapidly during flight.

Stratus clouds form over the Santa Clara Valley nightly during the summer whenever it is flooded by marine air and the layer next above is warm and dry. These clouds commonly form at a relatively high altitude. i.e., near the upper surface of the stratum of marine air, and subsequently grow downward, as established by the hourly observations of the height of the ceiling over the Oakland Airport. Although observations of the height of the ceiling show unmistakably its descent during the nighttime after the first appearance of the stratus cloud, yet undoubtedly there are times when the cloud grows both upward and downward from the altitude where the condensation first began. These clouds presumably are not due to turbulence since they form when the wind movement within the stratum of marine air is at its diurnal minimum. Moreover, eye observations show that there is little or no horizontal movement of the air within the cloud layer. There is, however, much convective turbulence within the stratum of marine air when its lapse rate exceeds the adiabatic. The top surface of the stratus clouds then indicates the existence of vertical movement and the pilots of planes experience bumpiness within and below them.

The actual origin of these clouds appears to be the excess of emitted over absorbed radiation. It is known that air rich in water vapor is selectively highly absorptive of terrestrial or long-wave-length radiation; and being a good absorber it also is a good radiator in the same spectral region, in fact as good, nearly, as a black body. Conversely, dry, clear air is diathermanous to terrestrial or long-wave-length radiation and therefore in that region a nonradiator, and its temperature subject to change only by work done by it or upon it. Hence at night the stratum of marine air rich in water vapor cools radiationally while the stratum of dry air above it remains at a constant temperature or, at most, loses its heat very slowly. The truth of this statement is proven by the marked cooling of the earth's surface at night, when the overlying air is still, while the air itself is cooling but little, except near the ground, and there by contact with the cold surface.

From the foregoing, the conclusion is reached that the formation of stratus clouds over the Santa Clara Valley during the summer is to be regarded as a radiative phenomenon, occurring when the valley is flooded by air of marine origin, rich in water vapor, and when it in turn is overlain by air of quite low humidity. When this situation exists the excess of outgoing over incoming radiation is at its maximum at the upper surface of the bay of marine air, and sometime during the night the cooling thus caused reaches the dew point, condensation starts and cloud forms. It does not necessarily follow that the dew point is reached first at the upper surface of the humid air; it may be at some intermediate altitude between this surface and the bottom. When the dew point is reached at the upper surface first, the growth of the cloud is downward; whereas when it is reached first at an intermediate altitude the growth of the cloud is both upward and downward. Ultimately the cooling throughout the marine air, from a maximum at its upper surface downward to a minimum at its bottom, may result in the lapse rate exceeding the adiabatic, when there will follow convection and turbulence that would cause a pilot passing through or under the cloud to experience bumpiness. This convective turbulence increases the rapidity of cloud formation. The descending currents, the counterparts of the ascending currents in the convective process, are not heated at the adiabatic rate for dry air, for in them there is a loss of heat by evaporation, the equivalent of that gained by condensation in the ascending currents. As the cooling proceeds the thickness of the cloud increases and at times the entire mass of marine air is filled with cloud from top to bottom.